DOCUMENT RESUME

ED 092 495 SP 008 084

AUTHOR	Kelly, Terence F.; Schieber, George J.
TITLE	Factors Affecting Medical Services Utilization: A Behavioral Approach.
INSTITUTION	Urban Inst., Washington, D.C.
SPONS AGENCY	Department of Health, Education, and Welfare, Washington, D.C.
REPORT NO	UI-0007-1
PUB DATE	Dec 72
NOTE	80p.
AVAILABLE FROM	Publications Office, The Urban Institute, 2100 M Street, N.W., Washington, D.C. 20037 (Stock No. URI-21000, $2.50)
EDRS PRICE	MF-$0.75 HC-$4.20 PLUS POSTAGE
DESCRIPTORS	Facility Utilization Research; Factor Analysis; Federal Programs; *Health Services; Individual Needs; *Medical Services; *Reactive Behavior; Surveys

ABSTRACT

This study describes behavioral response--both its theoretical specification and its estimation--which relates health service utilization and expenditures to a number of variables: demographic, psychological, economic, medical, and policy-related. By incorporating these behavioral relations into a recently developed microsimulation model, national and area demands for health services can be aggregated and contrasted for alternative health insurance schemes. The study uses data on individuals from the 1967 National Center for Health Statistics Interview Study and attempts to estimate the relationship between the demand for health services and various economic, demographic, and psychological factors. The study is composed of six chapters. Chapter 1 reviews the relevant health economics literature and draws inferences from this theory for use in the model. Chapter 2 describes previous quantitative demand studies which make use of microeconomic data bases. Chapter 3 describes the derivation of the theoretical context of the theoretical and empirical considerations. Chapter 4 discusses the 1967 study used as data base. In chapter 5, behavioral equations are estimated from this data base and the empirical results are discussed. Some concluding observations constitute chapter 6. (Author/JA)

Factors Affecting Medical Services Utilization: A Behavioral Approach

Terence F. Kelly
George J. Schieber

0007-1 December 1972

THE URBAN INSTITUTE
WASHINGTON, D.C.

The research reported herein was conducted with support from the U.S. Department of Health, Education and Welfare, under contract number HEW-OS-69-22. Data processing services from the Hendrickson Corportation. The views expressed are those of the authors and do not necessarily represent the views of the sponsor of the research or The Urban Institute.

UI 0007-1

REFER TO URI-21000 WHEN ORDERING.

Available from

Publications Office
The Urban Institute
2100 M Street, N.W.
Washington, D.C. 20037

List price: $2.50

A72/500

CONTENTS

INTRODUCTION

The drastic increase in health expenditures in the past few years has prompted deep concern among policy makers about the financing organization and delivery of health services in the United States. High costs incurred at the federal, state, and local level as a result of such health programs as Medicare and Medicaid, as well as a deep concern for the appalling health levels of certain segments of the population, have generated strong support for a comprehensive national health insurance program.

The key to a sensible formulation of national policy in the health care area is reliable information about how the beneficiaries of any such program will respond to the program. Information concerning the responses of the recipients of federal health programs is crucial in order to measure the overall costs and effectiveness of any proposed national health insurance scheme. In other words, effective policy decisions in the health area cannot be made without information describing the effect of alternative national health insurance policies on individual health service demands.

The purpose of this study is to estimate the relationships between health service demands and a variety of policy parameters. By incorporating these behavioral relations into a recently developed micro-simulation model, national and area demands for health services can be aggregated and contrasted for alternative health insurance schemes. The Urban Institute health utilization simulation model incorporates a modified version of these behavioral results in its estimation of the cost and distributional impacts

of alternative national health insurance plans.[1]

This study describes behavioral response--both its theoretical specification and its estimation--which relates health service utilization and expenditures to a number of variables: demographic, psychological, economic, medical, and policy-related. The basic--and novel--aspect of this estimation effort is the use of data on individuals from the 1967 National Center for Health Statistics Health Interview Study (NCHS-HIS) as our data base.[2] The NCHS-HIS data set contains demographic, economic, and medical information on about 134,000 persons in 42,000 households. Since this is the first study using the disaggregate data from this survey, a critical analysis of its content is undertaken prior to our estimation effort.

Although the health status of any given individual is a result of the interaction of numerous factors (environment, nutrition, climate, health services consumption, etc.), this study focuses primarily on the demand for health services.[3] The study attempts to estimate the relationship between the demand for health services and various economic, demographic, and psychological factors. Measuring the effect of health services on individual health levels is not the concern here. Similarly, the effect of nonhealth-related factors on health levels is not discussed due to data constraints, measurement problems associated with these factors, and the narrower scope of this study. The effect of these factors on the demand for health services

---

1. See [36].

2. See [34] for a description of the survey questionnaire and the data base. The NCHS-HIS is one of three parts of the National Health Survey. The survey for 1967 was the last year in which detailed third party payment, demographic, medical, and utilization data could be directly related. In the more recent surveys the payment questions have been omitted.

3. We use the terms health services, medical services, health care, and medical care interchangeably. However, frequently health services are defined to include all goods and services affecting health--not merely medical services.

will hopefully be discerned in the behavioral equations.

Likewise, except to the extent that they influence the demand for health services, factors such as supply are not specifically considered. Some of the issues which are beyond the scope of this study are: the organization of supply, the effects of alternative reimbursement schemes on supply, problems regarding the measurement of quality, measuring productivity, etc. However, the effect of supply on demand is taken into account in our behavioral model.

This study is composed of six chapters. Chapter I reviews the relevant health economics literature and draws inferences from this theory for use in our model. Chapter II describes several previous quantitative demand studies which make use of microeconomic data bases. These studies include the works of Wirick [37], Anderson [1], Rosett and Huang [30], and Grossman [14], [15]. Chapter III describes the derivation of our theoretical model in context of the theoretical and empirical considerations. Chapter IV discusses the 1967 NCHS-HIS data base. In Chapter V, the behavioral equations are estimated from the NCHS data and the empirical results are discussed. Some concluding observations constitute Chapter VI.

CHAPTER I

HEALTH DEMAND THEORY

At present, the theory of health economics from both demand and supply points of view is in an extremely primitive state. This is in large measure due to inadequacies in economic theory to handle the special circumstances surrounding the demand and supply of health services. These include the complex multi-party arrangements between consumers, providers and third party payment groups; imperfect (or a complete lack of) knowledge on the part of the consumer; high transaction costs; the high costs of obtaining information; the nonprofit status of large segments of the industry; monopoly control in certain parts of the industry due to licensing and certification requirements, the interdependence of supply and demand elements; supply and demand distortions incidental to alternative third party reimbursement mechanisms; inefficiencies introduced through the use of queues as nonprice rationing devices; the public nature of some of the goods and services in question (i.e. the existence of externalities); the dual investment and consumptive aspects of medical service utilization; the importance of market versus nonmarket time; stochastic elements in demand due to risk and uncertainty; difficulties in measuring health services; etc.

Recent health economic research has relied increasingly on new theoretical economic developments.

> Such developments include recent contributions to the theory of human capital; transaction costs and uncertainty; household production and the value of time; technological change and the process of diffusion of knowledge; interdependent utilities; and decision making in nonmarket-oriented sectors of the economy. [17, p. 7-8]

Grossman's [14] [15] approach, to which we now turn, embodies many of these theoretical advances.

The Human Capital Approach

One of the more rigorous treatments of health theory has been developed by Grossman [14] [15]. His model follows the human capital approach toward health.[1] Within the context of this approach, health is treated as a durable commodity. An individual inherits a stock of health at birth which depreciates over his lifetime. This depreciation can be retarded or offset (i.e. the health stock can be augmented) by investments in health augmenting services. Death occurs when the health stock falls below that level necessary to sustain life.

Based on this approach, demands for the health stock, health flow, and medical services are derived by maximizing the individual's lifetime utility, subject to budgetary and time constraints. The consumption of medical and other goods and services does not directly increase a person's health stock; rather, the combination of these goods and services with nonmarket time is the factor which yields gross profits in health and direct utility, and these then augment the goods and services which are endogenuously incorporated into the individual's intertemporal utility function.

The intertemporal utility function (the individual's lifetime utility function, U, of a typical consumer is defined as:

$$(1) \quad U = U(\phi_o H_o, \phi_1 H_1, \ldots, \phi_n H_n, Z_0, Z_1, \ldots Z_n)$$

where:

1. See [6], [22], and [24].

H_0 = inherited stock of health

H_i = stock of health in the i^{th} time period

ϕ_i = service flow per unit stock[2]

Z_i = good representing consumption of all commodities besides health in time period

n = length of life

[14, p 11-12]

Net investment in the stock of health is equal by definition to gross investment minus depreciation. That is:

(1.2) $H_{i+1} - H_i = I_i - \delta_i H_i$

where:

I_i = gross investment in health in time period i

δ_i = rate of depreciation of the health stock in time period i

[14, p.12]

Gross investments in health and the production of other direct utility augmenting goods and services are produced by consumers according to the following household production functions:

(1.3) $I_i = I_i (M_i, T_i; E_i)$

$Z_i = Z_i (X_i, T_{1i}; E_i)$

where:

M_i = medical care

X_i = market purchased goods and services that are inputs to the production of Z_i

T_i, T_{1i} = time inputs

E_i = stock of human capital[3]

[14, p.12]

2. Thus, "if ϕ_i were defined as the flow of healthy days yielded by a unit of H_i, h_i ($= \phi_i H_i$) would equal the total number of healthy days in a given year" [14, p. 14]. Parenthesized expression inserted for clarity.

3. E is intended to represent an efficiency measure of the household production process.

According to Grossman, since both market goods and own time are scarce resources, they both constrain the household production process. In the goods constraint, the present value of earnings income over the individual's life cycle plus initial assets is equated with the present value of outlays on goods:

$$(1.4) \quad \sum_{i=0}^{n} \frac{P_{mi} M_i + P_i X_i}{(1+r)^i} = \sum_{i=0}^{n} \frac{W_i T_{wi}}{(1+r)^i} + A_0$$

where:

P_{mi} = price of M at time i

P_i = price of X at time i

W_i = wage rate at time i

T_{wi} = hours of work at time i

A_0 = discounted property income

r = interest rate

[14, p. 13]

The time constraint posits that all possible uses of time must exhaust the total amount available in any period:

$$(1.5) \quad T_{wi} + T_{Li} + T_i + T_{1i} = T$$

where:

T = total amount of time available in any period

T_{Li} = time lost from market and nonmarket activities due to illness or injury [4]

[14, p. 13]

Solving equation (1.5) for T_{wi} and substituting the resulting expression into equation (1.4) yields the single full wealth constraint:

$$(1.6) \quad \sum_{i=0}^{n} \frac{P_{mi} M_i + P_i X_i + W_i (T_i + T_{Li} + T_{1i})}{(1+r)^i} = A_0 + \sum_{i=0}^{n} \frac{W_i T}{(1+r)^i}$$

[14, p. 14]

4. If $h_i = \phi_i H_i$ as defined in footnote 5, then $T_{Li} = T - h_i$.

By maximizing the intertemporal utility function (1.1) subject to constraints on net investment (1.2), household production (1.3) and full wealth (1.6), the equilibrium quantities of H_i and Z_i can be found.[5] In addition, the demand curves for health stock, H_i, health flow, $\phi_i H_i$, and medical care, M_i, are derived for both a pure investment and a pure consumption model. In these models, variations in the shadow price of health are related to shifts in depreciation rates, market efficiency and nonmarket efficiency.

The mathematical mechanics of solving the above system are not performed here, since our purpose is merely to present the "state of the art" of the existing theory. Grossman's empirical estimation efforts based on the mathematical solution of his model are described in the following chapter. However, in order to further explore the existing theoretical underpinnings of health economics, we will describe some of the theoretical constructs employed in previous health economic studies.

Theoretical Constructs

Our basic intent in describing some specific theoretical constructs and the operational measures of theoretical concepts employed in various health economic studies is to isolate these theoretical concepts and their measurement proxies. In other words, we are attempting to append some substance to the theoretical skeleton outlined above. Perhaps the appropriate place to begin is a further discussion of Grossman's work. As discussed above, Grossman pays extensive attention to one of the foremost problems

5. Grossman employs the standard Lagrangian type of maximization procedure. See [6]. However, this problem could also be set up and solved by optimal control theory techniques. See [5].

encountered in the area of health economics--that of defining and measuring the appropriate services and commodites demanded. As Grossman states, "what consumers demand when they purchase medical services are not these services per se but rather 'good health'." [14, p.5] In other words, the demand for medical services is one aspect of the demand for health. To put it somewhat differently, describing the demand for medical services is necessary but not a sufficient condition for describing the demand for "good health". The Grossman approach treats health as a consumer durable. Individuals inherit a stock of health at birth which depreciates over the life cycle but which can be maintained or increased by investment. Grossman employs four different dependent variables in attempting to estimate a health stock demand, a health flow demand, and the demand for medical services. These are: restricted activity days (flow demand); work-loss days adjusted for variations in weeks worked (flow demand); the stock of health of the individual as measured by the individual being in poor, fair, good, or excellent health (stock demand); and medical expenditures (medical service demand). Each of these variables is then estimated by multiple regression analysis from the independent variables age, education, sex, potential income (used as a proxy for wealth),[6] weekly wages, and family size. The family size variable is included on the basis of an assumption of complementarity of adult health stocks. Although there are many interesting features in this approach, the more important considerations in attempting to develop a health demand model are: the use of a family size variable, a potential or permanent income variable, and a work-loss variable.

6. See [14, p. 90]. Actually four different income measures are employed.

Andersen and Benham [2] in a recent study of the income elasticity of demand for medical care suggest some additional demand related factors. First, the authors make note of the heterogeneity of the demand for alternative types of medical services, noting in particular that the income elasticity of demand for hospital based physician services is lower than that for dental services. In particular, Andersen and Benham employ three different measures of medical services, two relating to physician care and one to dental care. Physician expenditures are employed as a measure of physician services. However, the authors point out that this measure may not accurately reflect the quantity of physician services consumed, due to variations in per unit price across families (depending on family income), free care available to certain individuals (low income, aged, disabled, blind), and regional differences in cost; and they then derive a physician use index. Dental expenditures are employed as the measure of dental services consumed. The basic model employed by Andersen and Benham relates medical care expenditures to income, price, quality, demographic characteristics, and preventive care variables. Illness level variables are also included in order to explore the relationships between illness and permanent and transitory income.

Rather than reviewing the Anderson and Benham results, we shall only point out some facets of their analysis that may warrant inclusion in a model of the determinants of health service utilization. First, the representation of variables in terms of different types of health insurance and free service would appear to be a valuable taxonomy. Second, the suggested use of a preventive care variable may be of interest theoretically, if not empirically. Third, although the quality variables used by Andersen and Benham are crude (quality is measured by "regular source of care," i.e., general practitioner, clinic, etc.), the justification for inclusion of a quality index would appear

quite real. Fourth, Andersen and Benham further point out that demographic variables in and of themselves do not explain the demand for medical care. Instead, they serve as proxy measures for such phenomena as family attitudes toward health and the availability of medical services. Finally, Andersen and Benham also cite the importance of a permanent income hypothesis in the demand for medical care.

Feldstein and Kelman [11] have developed a comprehensive model of the medical care sector. They indicate that the demand for medical services is primarily a demand for five types of general medical services: hospitals, nursing homes, doctors' office visits, outpatient visits, and home care. Patient days are used to measure the outputs of hospitals and nursing homes. Since the quality and variety of services offered differ among hospitals, the authors suggest the use of some index to measure the quality of care. Unlike the other medical services, home care is assumed to be an inferior good whose demand is negatively related to income and price. The price of hospital and nursing home care is postulated to be set to cover average costs, but in the other three services price is assumed to be determined by the interaction of the conventional supply and demand factors. One omission in the model is the demand for drugs.

A 1964 report from HEW [33] provides a comparable breakdown of medical facilities utilized by consumers. The report suggests a three category breakdown of patient care facilities. These are:

1. General and special short term hospitals (patient stays less than 30 days);
2. Long term institutions (mental and chronic disease hospitals, nursing homes);

3. Ambulatory care facilities (medical care supplied to non-hospitalized patients).

The report further suggests the classification of hospitals and long term institutions (1 and 2 above) by ownership-sponsorship approvals and accreditations, size of facility (beds) and occupancy rates, and special services available. Although these factors pertain largely to supply side considerations, they may have some important effects on demand. The report further suggests that hospital care can be measured in terms of admissions (or discharges) of bed patients, hospital days of care, and distribution of cases and days by length of stay. Returning to the demand side, the report suggests ascertaining utilization and price data on the following manpower facilities: physician's services, dental services, general hospital care, drugs and appliances, and other miscellaneous services. The above categorizations of health care facilities and utilizations may provide some insight in specifying the dependent variable (s) in our model.

The most recent and comprehensive treatment of the medical sector is provided by Yett et al. [38]. They specify a complete model of the medical sector postulating numerous relationships between the supply and demand for health services, health manpower, and health education. Because of the size and complexity of the model, only certain aspects of it can be discussed here. The authors point out that the two most important factors regarding the demand and supply of medical services are:

> (1) the complex multi-party arrangements characteristics of the transactions in health services markets (especially those for inpatient care); and
>
> (2) the general lack, and/or high cost, of information available to the consumer regarding the nature, quality, and often even the alternative prices of the output he is considering buying.
>
> [38, p.50]

The authors point out that insurance reduces substantially the cost of care for those services covered and that the reimbursement methods have varying incentive effects on the suppliers of medical care. Another aspect of the health market is the possibility of substituting one type of health service for another. Additional factors that affect the demand for health services are: marital status (measuring to some extent the availability of home care), the cumulative effects of unmet needs on the poor and certain minority groups, and residence (measuring the accessibility of health information and services). Although Yett et al. provide a disaggregation of health facilities comparable to the HEW classification outlined above, they also suggest a far simpler breakdown in terms of three types of facilities: doctors' offices, hospitals, and nursing homes. In studying the possible impacts of alternative government health policies, they point out the salient fact that increased Medicaid coverage may lead to increased demand for medical services which impose costs through higher prices on those individuals not enrolled in the program. In addition, the increase in Medicaid coverage may create demands for different types of health services according to the health characteristics of recipients.

Several additional factors that should be considered in a health utilization model are the effects of paid sick leave, manual vs. white collar occupations, family conditions, and group attitudes toward illness.[7] The interdependent nature of demand and supply in the medical services area, both in terms of the physicians' influence on the patients' decision making and the locational effects of facilities (the demand for most medical services is local), is an important aspect of an individual's demand for medical services.

7. See [12, p. 161].

In a similar vein, demand models for medical services should take account of consumption complementarities (and substitutabilities) between alternative types of medical services. Of further interest is the fact that an individual's stock of health is partially predetermined by heredity, environmental factors, and the consumption of non-health related goods and services. Employing Grossman's notation, this implies that H_i depends not only on investments in medical care, I_i, and depreciation but also on the consumption of other non-medical commodities.

Given the tremendous importance of health insurance as a price component in the demand for health services, we will now discuss some of the theoretical and structural aspects of health insurance.[8]

Theoretical Basis for Health Insurance

The purpose of health insurance is the sharing of risks. According to Arrow, "there are two kinds of risks involved in medical care: the risk of becoming ill, and the risk of total or incomplete or delayed recovery." [4, p. 959] Neither of these risks can be completely covered by insurance. If we assume both that individuals are risk averters and that the individual's medical risks are independent, then health insurance provides a means of pooling risks, thereby reducing the expected risk to any individual. To put this in Arrow's more precise terms:

> It follows from the assumption of risk aversion that if an individual is given a choice between a probability distribution of income, with a given mean m, and the certainty of income m, he would prefer the latter. Suppose, therefore, an agency, a large insurance company plan, or the government,

8. See [8] and [27] for detailed theoretical discussion of national health insurance.

> stand ready to offer insurance against medical costs on an actuarially fair basis, that is, if the costs of medical care are a random variable with mean m, the company will charge a premium m, and agree to indemnify the individual for medical costs. Under these circumstances, the individual will certainly prefer to take out a policy and will have a welfare gain, thereby. [4, p. 959-60]

National health insurance on the other hand is a social risk-sharing mechanism that is financed and organized nationally.[9]

Structural Features

Four interactive structural features generally describe a typical health insurance plan. These features are the benefit coverage, premiums, deductibles, and copayments (coinsurance).[10] Benefit coverage can be described by two parameters: type of medical service covered, and amount of (limits in) coverage. The amount of coverage for any particular service can be specified in terms of expenditure limitations or utilization limits. The benefit coverage is an extremely important aspect of any program since, as Pauly states, "it determines both the cost and the attractiveness of the insurance package." [26, p.9] Premiums are generally set to cover the actuarial value of the benefit package. Once the premiums have been paid, they have no effect on either the average or marginal price of medical services. Consequently, it is doubtful that premiums can promote proper use of medical facilities.

Deductibles and copayments affect the average and marginal price of medical services and hence affect medical facility utilization. Deductibles and copayments have often been used to eliminate the "moral hazard of insurance". In an optimal insurance policy, the desired situation is for

---

9. See [8, p. 2].
10. See [26] and [28].

the individual to have no control over the event against which he has insured himself. Unfortunately, this is practically never the case, especially in medical service utilization. "This 'moral hazard', in which the presence of insurance affects the likelihood of the occurrence of the insured event, arises because insurance of the usual type lowers the user price of care, thus stimulating increased private demand." [26, p. 4] Deductibles attempt to guard against this contingency by requiring the individual to absorb all medical costs up to a certain point. Once the deductible amount has been paid, deductibles have no effect on the (marginal) price of medical care. Thus a deductible affects the average price of medical care but not the marginal price above the deductible limit. Below the deductible limit, the market price for medical services determines the average and marginal prices. Deductibles can be used selectively to promote or discourage utilization of various types of medical services. Copayments, like deductibles, can be used to encourage or discourage utilization of various services. They generally require the individual to pay some fixed amount [proportion] of his medical expenses. However, copayments affect the marginal price of medical services. Copayments would appear to be a somewhat more effective device to promote allocative efficiency, since unlike deductibles they affect the price of medical services throughout the entire continuum of use (above the deductible).[11]

The price effects of the provision of insurance and its basic structural components of copayments, deductibles and limits can be demonstrated graphically. For simplicity, we assume that M is the only medical service

11. A distinction is made between copayments and coinsurance; the former being an amount and the latter being a rate. Thus, a copayment is a fixed amount of the bill above the deductible which must be paid by the individual, while coinsurance is a percentage of the bill above the deductible which must be paid by the consumer.

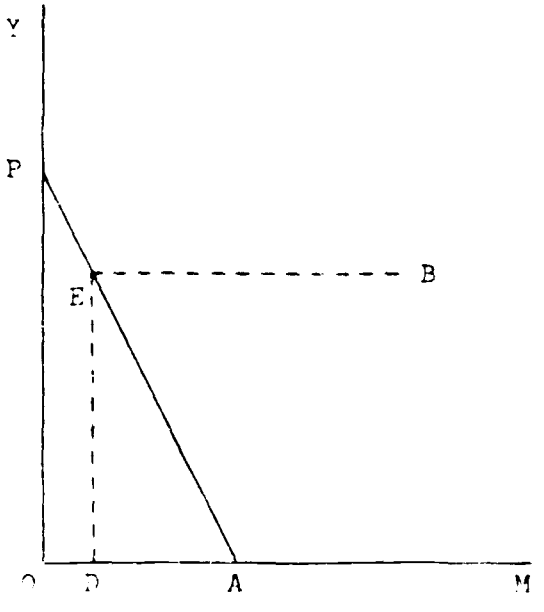
available and that Y represent all other goods and services. Let PA be the original budget constraint whose slope is the ratio of the price of medical care to the price of all other goods and services.

In case I, we assume that without insurance the consumer's budget constraint is PA. The budget constraint is altered to PEB by providing an insurance policy with a deductible operative up to OD units of service and with complete coverage for all medical services above this deductible.

In case II, introduction of an insurance policy with copayments, but without deductible or limits, rotates the consumer's budget constraint from PA to PC, indicating a decline in the medical service price relative to the price of the other goods. In case III, introduction of an insurance policy with a deductible up to OD units of service and copayments thereafter results in the new budget contraint PEC. In other words, as long as the deductible limit has not been reached the individual will behave as if he had no insurance; however, at point E a new budget constraint determined by the effect of the copayment on the price of medical services is operative. The smaller the copayment provision, the greater is the shift outward and to the right of the EC portion of the budget constraint which in the limit of no copayments= EB in case 1. In case IV, the combination of a deductible up to OD, a [illegible] payment from OD to OL, and no coverage above OL, results in the consumer facing budget constraint PEFG. In this case the slope of the FG segment being equal to the slope of the PE segments indicates that the consumer faces the same price ratios above the limit as he did when he had no insurance or when he was in the deductible range; however, he would be better off (FG indicates a larger budget than PA) to the extent that insurance in the DL range leaves him with more income than he would have had if he were without insurance.

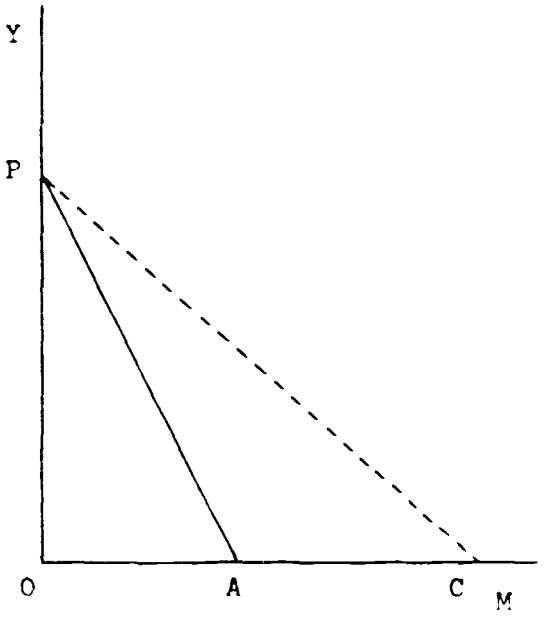
Case I

Insurance covers all utilization of medical services above the deductible of OD units. No copayments or limits on coverage.



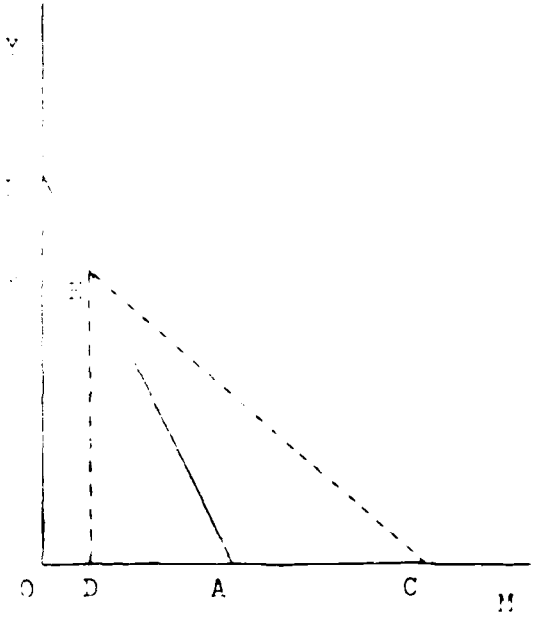
Case II

No limitation on Coverage, No Deductible; Copayments required through entire range of use.



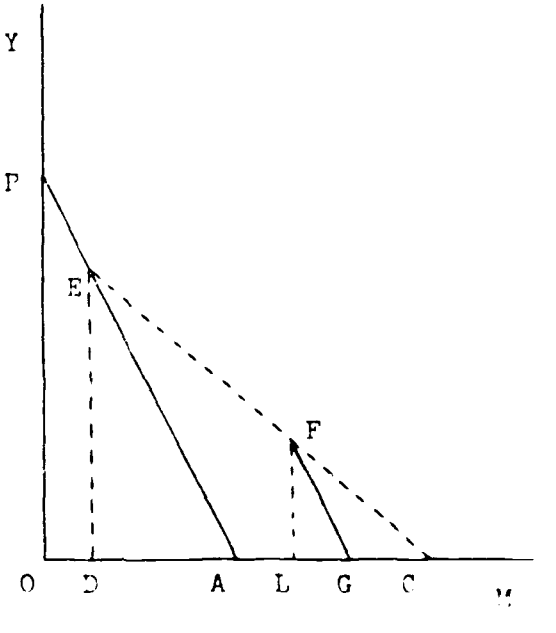
Case III

Deductible up to OD; Copayments thereafter; No limits.



Case IV

Deductible up to OD; Copayments from OD to the limit of coverage at OL.



The above discussion is somewhat incomplete for two reasons. First, by its reliance on traditional demand theory and its concommitant assumptions about constant prices (marginal = average price), the effect of deductibles on (average) price is not adequately taken into account. Second, the effects of deductibles, copayments, and limits on utilization have not been explored since we have not imposed indifference curves on the budget contraint diagrams, nor have we shown utilization changes as a result of alternative insurance features. This, however, has been a deliberate omission. Since any measured utilization changes would result from assumptions about the slopes of the relevant curves (budget constraint and indifference curves), the resultant measured income and substitution effects would be a result of so many factors that it would be difficult to partition these effects between insurance components and preference valuations. Thus, although the above discussion is far from complete, it would appear to be a reasonable approach in simply identifying the price effects of the provision of health insurance and its embedded structural features.

Summarizing the above information about the health market leads to the following suggestions. First, the demand for health should be specified in terms of the demand by individuals for the various medical services, such as doctors' office visits, hospitals, and nursing homes or, if the data permit, the more disaggregated version of these facilities as specified by HEW, or the breakdown-suggested by Kelman and Feldstein.[12] Second, care must be taken in measuring each of these types of service in terms of the appropriate

12. If certain medical services are thought to be complements or substitutes for other medical commodities, then the prices of these services should be included in the demand equations for the latter commodities in order to obtain the cross-elasticity of demand.

units. Third, the interdependence of demand and supply factors in terms of both locational, and physicians' advice factors should, if possible, be taken into account. Fourth, some kind of permanent and/or transitory income component(s) should be incorporated into the model. Fifth, a family size variable should be employed as a partial measure of home care and as a representation of the complementarity of family health needs. Sixth, in attempting to assess the impact of alternative policy formulations, there should be an examination of the opportunity costs in terms of price changes and supply changes. Seventh, if possible, it would be of interest to determine the effect of a preventive care variable. Eight, indices should be developed wherever feasible to take account of qualitative differences in medical services. Ninth, demographic varaiables may measure the cumulative effects of previous unmet health needs in addition to current demands for health. Tenth, the substitutability (and complementarity) of different types of health care should be taken into account by computing the appropriate cross-elasticity measures. Eleventh, variables representing work loss, occupation, paid sick leave, and group attitudes toward illness may help to increase the explanatory power of any such model. Twelfth, health insurance coverage as represented by the structural parameters of premiums, copayments, limits, and deductibles is an important determinant of the price of medical services. (These demand components are summarized in tabular form in Chapter III.)

CHAPTER II

REVIEW OF PREVIOUS EMPIRICAL ESTIMATION EFFORTS

This section of the analysis reviews four previous estimation studies: Wirick [27], Anderson [1], Rosett and Huang [30], and Grossman [14]. These analyses are chosen for three reasons. First, they all make use of micro-economic data bases. (In other words, the individual or the family is the basic unit of observation in each of these studies.) Second, each of these studies employs single equation models and analysis of variance measurement techniques which are also employed below in our behavioral estimates.[1] Third, these studies emphasize the effect of several other factors in addition to price on individual medical utilization.

The Wirick Study

The Wirick study is based on a 1958 multi-stage area probability sample of 2,500 households in Michigan. After some screening, the final sample employed by Wirick contained responses for about 3,500 individuals in 1,000 families. These data were employed to determine the factors that influence the demand for medical care, both at an aggregate and at a disaggregate level. At the aggregate level, Wirick attempts to explain the demand for total medical care measured by total medical expenditures; and at a disaggregate level, he attempts to explain the demand for hospital care, doctor care, dental care, prescribed medicine, and other expenses. Hospital care is

1. Our statistical methodology is discussed in Chapter V.

measured as the number of days in a hospital during the past year. Doctor and dental care are measured by the number of visits during the past year. Prescribed medicines and other expenses are measured as the actual amounts spent.

The basic theoretical model postulated by Wirick attempts to explain each of these medical care demands for individuals in terms of five components: physiologic need, realization of need, resources, motivation, and availability of service. Age and sex are always employed to represent physiologic need, but the variables employed to represent the other demand components depend on the particular medical service that is being "explained." Table I below, which is reproduced from Wirick, contains a list of these variables.

Employing a modified analysis of variance technique,[2] Wirick found that " ... variance in different components of medical care was often explained by the same predictor but that the importance of predictors still varied considerably from component to component," [1, p. 12]. Another interesting result is that the disaggregated component equations on the whole contributed to no great improvement in explanatory power in terms of higher R^2 than did the aggregate equation. Therefore, from the point of view of predicting medical expenses, the aggregate equation performed as well, if not better, than the disaggregated components. However, as Wirick himself points out: "predictive ability of the equation is not unimportant, but a set of equations that gives no improvement in predicting total expenses can give an improved understanding of the composition of demand. In a sense, this represents an improvement on predictive ability beyond that shown by R^2."

---

2. See [31].

TABLE 1

Hypothetical Structure of the Demand for Medical Care As a Multi-Equation System

Aspect of Demand Expressed by the Variable	Component of Demand: Hospital Care (Number of days in hospital during the year)	Doctor Care (Number of visits, excluding those for injections only)	Dental Care (Total number of visits during the year)	Prescribed Medicine (Total amount of expenditures on prescribed medicine)	Other Expenses (Total expenses, including those for prescribed medicine)
Physiologic need	Age Sex	Age Sex	Age Sex	Age Sex	Age Sex
Realization of need	Home care Prescribed medicine	Attitude to early care Hospital days	Attitude to early care Education of head	Attitude to early care	Family size Early environment of family head
Resources	Insurance Liquid assets	Adj. income Inst. debt.	Family income Liquid assets	Family income Inst. debt	Insurance Adj. income
Motivation	Doctor visits	Unmet needs	Family size Doctor vists	Doctor visits	Hospital days
Availability of service	Index	Index	Community income level	-	-

Source: Grover Wirick, "A Multiple Equation Model of Demand for Health Care," Health Services Research (Winter, 1966), p. 308.

The actual results obtained by Wirick suggest the following:

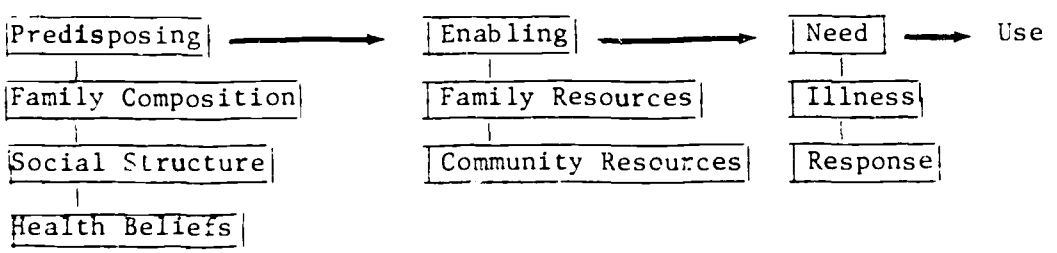
1. Only two need factors (maternity and age) out of 17 variables provide any appreciable reduction in the unexplained variance for total medical expenses. None of the economic variables were significant (R^2 = .15).
2. Two stage estimating procedure is employed for the hospital care (days) component. The significant variables were age, prescribed medicine, receipt of public aid, and size of community. (R^2 = .082 for the first stage and .127 for the second).
3. The primary explanatory variable for physician care is number of days in the hospital, indicating a joint dependency between hospital days and physician care (R^2 = .158).
4. Dental care is best explained by number of doctor visits, age and family income (R^2 = .236).
5. Prescribed medicine expenditures are best explained by number of doctor visits and age (R^2 = .193).
6. Other medical expense is best explained by age and number of days in the hospital (R^2 = .146).

Several observations regarding the above results are apparent. First, part of the reason for the relatively low R^2's is the large number of non-users of the various components of health care. A second observation regarding the joint dependencies of several endogenous variables suggests the appropriateness of a simultaneous equations approach. A third observation is that "... the resource variables, although playing some role in each of the component equations except that of other medical expenses, generally played only a minor role--contrary to expectation and to the results obtained in other studies." [37, p. 343). Fourth, the author suggests

that need and resource variables should be specified as precisely as possible. In particular, Wirick suggests the use of physical conditions as a measure of need, instead of the age and sex proxies.

The Andersen Model

The Andersen model is based on a 1963 nationwide survey of 2,367 families conducted by the Health Information Foundation and the National Opinion Research Center (NORC) of the University of Chicago. Unlike the Wirick study, the Andersen study attempts to measure family rather than individual demands for health services. Andersen posits that family health demands are a function of a sequence of three components: predisposition, ability to obtain services, and need. "Use is dependent on: 1) the predisposition of the family to use services; 2) their ability to secure services; and 3) their need for such services." [1, p. 14]. The subcomponents of the predisposition element are family composition, social structure, and health beliefs. The family's ability to secure services, the enabling component, is subdivided into family and community resource components. The need variable is disaggregated into illness and response subcomponents. These components are represented diagrammatically by Andersen as follows:



Source: Ronald Andersen, A Behavioral Model of Families' Use of Health Services (Chicago: Center for Health Administration Studies, 1968), p. 14.

As his basic unit of measurement of family use, Andersen derives a homogeneous index of health services utilization.[3] Employing the same analysis of variance techniques as Wirick, Andersen found that the need component (especially the disability day variable) explained the largest proportion of the variation in total health service utilization. The enabling component variables (health insurance, welfare care, and regular source of care) explained only a relatively minor amount of variation. Disaggregating his utilization index into hospital, physician and dental use, Andersen is able to explain 27, 47, and 19 percent of the variance in utilization respectively. Once again, the enabling components explained little of the variation in all three kinds of services. The variation for the hospital services utilization was explained largely by age of youngest member, a predisposing component, and disability days, a need component. For physician services, family size (a predisposing component), disability days and seeing a doctor for symptoms (need components) accounted for most of the explained variation. For dental services, employment of main earner, education of head, and family size (predisposing components) accounted for most of the explained variation.

In concluding his analysis, Andersen cites several possible modifications that might lead to better predictions. First, he suggests use of a clinical measure of need as opposed to a family reported measure of need. Second, improved measures of family resources, such as permanent income and type of insurance, are suggested as possible modifications to improve explanatory power. Third, Andersen suggests that since some studies indicate that final decisions in the health area are made by the wife, responses of the wife rather than the family head may lead to more accurate survey information. Finally, specific measures of the community in which the family lives are also proposed as improvements to his basic behavioral model.

3. See [J, pp. 21-30].

The Rosett and Huang Study

The Rosett and Huang study is an extremely ambitious attempt to estimate changes in medical expenditures resulting from alternative insurance plans. It is more computationally complex than the Wirick and Andersen studies and is undertaken with a rather different objective. Thus, while Wirick and Andersen attempt to determine the behavioral motivations behind the demand for medical services, Rosett and Huang are more interested in prediction than explanation. The data employed by Rosett and Huang are from the Bureau of Labor Statistics 1960-61 Survey of Consumer Expenditures. The survey contains data on 13,728 urban and rural U.S. households. Since the data only cover household expenditures on premiums and direct medical payments, the authors must derive household data on the benefits paid by insurance companies. By grouping households together and performing a series of complex adjustments, the authors derive a data series on household medical expenditures paid by the insurance companies. Rosett and Huang employed Tobin's probit regression model (to reduce variance introduced by a large number of zero expediture households), and then estimated two equations to predict medical expenditures--one for insured households, and one for uninsured households. Both equations present as independent variables household income, dental expenditures (as a measure of aversion to pain), and a series of demographic variables. In addition, the insured household equation includes as an independent variable the proportion of household expenditures that are paid (reimbursed) by the insurance company. Assuming perfectly elastic supply, these equations are then employed to compare reimbursement and indemnity insurance and to predict medical expenditures under alternative assumptions of insurance coverage (including deductibles and the assumption that uninsured households will behave like insured households once they are

given insurance).

A review of Rosett and Huang's empirical results is tedious and of questionable value for our objectives, and we shall therefore only review their basic methodological contributions which relate substantially to our behavioral estimates and to any forecasting which might be done with our estimated equations. First, the use of Tobin's probit regression may be of value in any estimation efforts involving medical data bases containing large numbers of zero users. Second, the assumption of perfectly elastic supply is also necessary in our model (if we are interested in predicting aggregate expenditures) since we lack the requisite supply data to set up a multi-equation interactive system. However, we agree with Rosett and Huang who justify this assumption:

> Of course, we do not believe that the supply is perfectly elastic, nor do we believe that under a national medical insurance plan expenditures on medical care would double or triple. We think of our estimates as providing a forecast of the excess demand that is likely to obtain under various national medical insurance plans and of the consequent market pressure that will require administrative control.
>
> [30, p.]]

Third, in order to predict aggregate behavior from the individual behavioral responses, the assumption that uninsured households will behave in the same manner as insured households once they are given insurance must be employed in our model, given the form of the 1967 NCHS. (In order to simulate deductibles, Rosett and Huang also assume that insured households behave in the same manner as uninsured households up to the deductible limit.)

The Grossman Model

Grossman, like Andersen, employs the 1963 NORC sample; however, unlike Andersen, his basic unit of observation is the individual rather than the family. Demand curves are estimated for the health stock (H_i), health flow ($\phi_i H_i$), and medical care (M_i). The health stock variable is represented by a variable indicating whether the individual considers himself to be in poor, fair, good, or excellent health. Restricted activity days and work-loss days corrected for weeks worked are each used as measures of health flow. Expenditures on medical services are employed as the measure of medical care in the medical care demand equation. The independent variables in each of the demand equations are the individual's age, education, sex, weekly wage, family income, and family size. Since variations of the income variable are employed, five demand equations are estimated for each of the four dependent variables.[4]

The empirical results are generally in harmony with those of the previous studies. In the stock demand equations, each of the five income measures employed was $R^2 = .17$. In the flow demand equations, when flow demand is represented by work loss days corrected for weeks worked, the R^2 ranges between .07 and .08; and when restricted activity days represent flow demand the R^2 ranges between .05 and .06. In the medical care demand equations, the R^2 ranged between .05 and .08. The age variable is negative and statistically significant in all the health stock and health flow demand equations. In the medical care demand equations, the age variable is, as expected, positive and statistically significant, while the education variable is positive but not statistically significant. The wage variable is

4. One variation excludes the income variable.

positive and statistically significant in the medical care demand equation. The income variable is generally negative, but sometimes it has a small positive value and is occasionally statistically significant in the health stock and flow demand equations, while the income coefficients are always positive and statistically significant in the medical care demand equations. The sex variable is negative and usually statistically significant in the health stock demand equations, both negative and positive, but not statistically significant in the medical care demand equations. The family size coefficients are negative and not statistically significant in the health stock and medical care demand equations, and positive and usually significant in the health flow demand equations.

In summarizing the results from these four studies, several observations seem warranted. First, none of the studies is able to explain a significant amount of the variation in medical service utilization or expenditures. Second, need factors such as age and sex generally appear to be the most important explanatory factors. Third, although the studies tend to differ somewhat in their objectives (and hence in the emphasis placed on certain variables), they are fairly consistent in suggesting the variables which should be included in future studies. These would include: age, sex, race, income, family size, percent of bill covered by insurance or other third parties (welfare, veterans administration, etc.), education, residence, other need measures such as maternity status or physical conditions, occupation, attitudes, etc. Fourth, the studies suggest the use of special statistical techniques, such as probit analysis, indicative the possible presence of non-linearities in the data.

CHAPTER III

THEORETICAL MODEL

Our theoretical model is based on traditional consumer demand theory and the prevailing health demand theory outlined in the previous two sections. The demand for health services is functionally related to price, family resources, tastes and preferences, needs, and supply components. This taxonomy differs somewhat from traditional consumer demand theory in three ways. First, the usual taste and preference category is disaggregated into two categories: one representing the usual taste and preference components; and the second representing need, which, as discussed below, is a special circumstance arising in medical situation.

The second basic difference from traditional theory is the incorporation of a supply component directly into the demand equation. As discussed above, there are two reasons for this. One, a supply component should be included in order to allow for the possibility that the physician is actually the de facto demander of most medical services. Two, a supply measure should be included in the demand response in order to account for the effect of supply constraints on demand. In other words, data on medical service usage reflect satisfied effective demand (sometimes called utilization) as opposed to unconstrained effective demand. To a large extent, direct inclusion of a supply variable in the demand equation is necessitated by the usual data constraints which preclude specification of a simultaneous equation method. Of course, to the extent that supply is actually inelastic in the short run, a simultaneous equation approach may be unnecessary. However, if the behavioral equations are to be employed to make long-run predictions, a separate supply equation

would be desirable.

The third modification of the traditional theory is the omission of the prices of other goods and services. Since requisite data on the prices of other goods were unavailable, we followed the usual procedure in cross-section studies of assuming that these prices can be taken as given (assumed constant).[1] Unfortunately, this exclusion precludes the estimation of cross-elasticities of demand.

The above modifications of traditional demand theory are discussed below in conjunction with a detailed disaggregation of the basic demand components suggested by the existing health economic theory. Table 2 contains this taxonomy.

Behavioral Response Components

Need: The level of need experienced by an individual is a major determinant of his demand for health services. However, the level of need perceived (felt) by an individual may differ greatly from his actual (real) need. Indeed, without some obvious symptoms such as pain, injury, rash, etc., the individual may have no perceived need at all even though he has some actual need. In most cases, the actual need for medical services is identified through an interaction between patient and trained medical practitioner. It is the latter who generally identifies the individual's actual need. (For example, although a poor person may not feel well, his perceived need probably differs greatly from his actual need due to the cumulative effects of unmet needs. These needs whether properly appraised or not by the individual are then an integral component of that person's demand for and

1. For simplicity, we shall also abstract from the quality problem by assuming that quality differentials are reflected in the price of the service.

Table 2

Health Demand Components

Price

1. Insurance Coverage
   a. Deductibles
   a. Coinsurance
   c. Limits
   d. Premiums (Paid by Employer)
      (Paid by Self)
2. Free Care
3. User Charges
4. Opportunity Cost
   (Paid sick leave, value of time)
5. Availability of Home Care

Resources

1. Income
   a. Temporary
   b. Permanent
2. Assets
   a. Ability to Obtain Loans
   b. Savings, Stock, Real Estate, etc. (Wealth)

Supply

1. Physician/Population Ratio
2. Hospital Beds/Population Ratio
3. Geographic Distribution (concentration) of Doctors and Hospitals.

Needs

1. Perceived Conditions
2. Actual (Sex, age, race
   a. Accumulated Unmet Needs
   b. Preventive Care
3. Complementarity of Family Health Needs
4. Occupation (White collar vs. Blue)
5. Industry

Tastes and Preferences

1. Economic
2. Psychological
   a. Attitudes (individual and group)
3. Demographic
   a. Education (head and individual)
   b. Residence
   c. Religion
   d. Sex
   e. Age (head and individual)
   f. Race
   g. Life Cycle
      (1) Marital status
      (2) Family size
      (3) Ages of children
      (4) Number of children

utilization of health services in either a consumptive or investment context. One problem regarding the inclusion of need in a model is its unit(s) of measurement. The measurement of need whether perceived or actual and the differentiation between these aspects of need are difficult problems. The most precise measure of need is the actual physical condition attributed to the individual as measured by some established medical coding scheme, such as the International Classification of Diseases. The basic problem in using the physical conditions reported in survey type data is that those individuals with no utilization and no physical conditions reported may in fact have some actual need despite the absence of perceived need. Making health resources available to these individuals either indirectly through the provision of health insurance or directly through the provision of services could lead to large increases in the utilization of health services. Since federal health policies are ideally concerned with satisfying actual rather than perceived needs, the use of the survey data described above would undoubtedly lead to underestimates in the demand and utilization of health services. One possible solution to this problem is the use of data derived from actual physical examinations of the entire sample by trained medical personnel.[2] Because of the above mentioned problems with physical condition data, the indicators of need generally employed are age, sex, and race. In addition to these, family size measures (family size, number of children, etc.) serve as indicators of the complementarity of family health needs. Industry and/or occupation classifications also affect an individual's need for health services (hazardous occupations, etc.). The number of physician visits by the individual in the past twelve months is another measure of need. Previous

2. The Health Examination Survey satisfies these criteria. Unfortunately, the sample size is relatively small. See [35].

preventive care is another factor affecting need. The individual's education level is frequently used as an indicator of such care. (It is also a measure of tastes, as are family size and number of children).

Tastes and Preferences: An individual's tastes and preferences are another determinant of his health service utilization. Tastes and preferences are determined by the simultaneous interaction of a myriad of economic, psychological and demographic factors. The most important economic variable would be either individual or family resources. Although resources in and of themselves affect utilization directly, they also influence tastes and preferences. Psychological factors such as individual and family attitudes toward health interact with numerous demographic factors in determining an individual's tastes and preferences. These demographic variables include education, residence (SMSA), religion, sex, age, race and family cycle variables such as marital status, family size, number of children, ages of the children, age of the family head, and the education of the family head.

Resources: Family (or individual) resources are another factor affecting utilization and demand of health services. Several studies ([1], [2], [14], [37]) have indicated that a family's or individual's total resources (and/or permanent income), defined as actual or potential command over resources, is the relevant income concept. This concept embraces both temporary and permanent income, wealth (savings, stock, real estate, etc.) and the ability to obtain loans from friends, relatives, or institutions. In addition, various components of family income such as individual earnings and wage rates serve as indicators of the opportunity cost of an individual's time, an important and often neglected price component.

Price: The price component of our behavioral model is conceptually the simplest to specify. Assuming medical services are normal goods, one expects the demand for health services to be inversely related to price. From an operational point of view, however, specification of a price for medical services is quite difficult. The actual price an individual pays for medical services is determined by at least three basic components: a direct monetary component, a time component, and a non-pecuniary illness component.

The direct monetary component of the price faced by an individual is determined by insurance, the market price of the service, the availability to the individual of free care (from the provider or at home) and transportation costs. The existence and level of an individual's insurance coverage are probably the most important determinants of direct monetary costs. The decision to buy insurance depends on premium levels, individual risk aversion preferences, and numerous other economic and demographic factors. (Of course, the insurance may also be provided by the individual's employer.) Once an individual has obtained an insurance policy, the actual level of coverage depends on the limit, copayment and deductible features of the policy and the actual prices charged by the providers of medical services. Two other factors affecting the direct monetary price are the willingness of providers to give free care (or care at lower prices) to the indigent and the availability of home care as an alternative to market provided care. Another direct monetary price determinant is the transportation costs an individual faces. The greater the distance which must be travelled to the health facility and the less efficient the local transportation system, the greater the monetary transportation costs. (These factors also affect the time costs discussed below.)

The second basic component of the effective price faced by an individual is the value of the time (opportunity cost) used in obtaining care. This is to a large extent determined by the individual's valuation of his time as determined by his wage rate, availability of paid sick leave, and his non-market activities (value of leisure, household production, child care, etc.), Time costs may be appreciable when significant amounts of time are spent recuperating from an illness, waiting for service at a medical facility, or in transportation (exclusive of monetary transportation costs) enroute to the facility.

Nonpecuniary illness factors also determine the price that an individual pays for medical services. These factors are primarily reflected in the physical pain, limitations of activities, psychic dis-utility accompanying most illnesses (and/or preventive procedures).

Capturing the effect of these three basic components of effective price is beset by difficulties. At least four basic problem areas can be identified with regard to representing the price components in a behavioral health demand model. These are: measurement problems, data limitations, behavioral uncertainties, and statistical problems. The first three problems relate to the appropriate specification of the price variable while the last relates to the estimation techniques employed. Measurement problems occur because it is almost impossible to measure quantitatively or qualitatively the non-pecuniary illness component described above with sufficiency accuracy. Data limitations inherent in varying degrees in most health surveys limit the ability to include some of the quantifiable components of price. Uncertainties as to the proper behavioral relationships between the price components themselves and the other components of the model further confound the problem of appropriate specification of the price component. Lastly, statistical

problems resulting from interrelationships among various components of the model (multi-collinearity, serial correlation) as well as various statistical biases (aggregation bias, simultaneous qquations bias, etc.) may lead to the estimation of erroneous behavioral relationships.

Due to these limitations, certain price variables are omitted from most behavioral estimation efforts, and crude proxies are used for others. Since nonpecuniary illness costs are seldom measurable, they are omitted from the demand model. Ocassionally, if good data are available on the physical condition of the individual, the conditional code may serve as a proxy for this aspect of price. Unfortunately, a great deal of variance exists regarding type and intensity of illness, even for the rather detailed International Classification of Disease (ICD) codes. Medical surveys seldom reveal any information about time costs. Frequently, the individual's wage rate is used as a proxy for such costs under the assumption that the higher the wage rate, the higher the opportunity cost of time. The monetary price component is usually the most readily available and easiest to represent. However, transportation costs, the cost of the premiums (and who pays them), and the insurance coverage limitations are seldom available from survey data. This precludes endogenous determination of the decision to obtain insurance (as opposed to the effective price an individual faces because he has insurance). In some instances, available price data include information on the total bill and the amount of this bill paid by third parties. It is usually not possible to disaggregate this latter figure into deductible and copayment amounts.

Because of these problems, most medical demand studies employ some variant of the following components: price per day (total bill divided by number of days), or percent of bill paid by insurance (amount of bill paid

by insurance divided by total bill). However, if price variables are specified in this form, it is impossible to discern the separate effects of copayments, limits, and deductibles on behavior. Furthermore, these representations of price imply that average, as opposed to marginal, prices determine demand.

It is difficult to estimate the degree of the inaccuracy introduced in the behavioral demand functions by employing average as opposed to marginal price measures. However, since: a) most hospital insurance plans do not have deductible features; b) typical consumers do not generally possess sufficient information about the health sector to make marginal calculations; and c) treatments themselves are often "lumpy" and not easily amenable to fragmentation into marginal components, it is quite possible that the price variables specified above may provide reasonably accurate representations of the price actually faced by consumers.

Supply: Supply constraints, such as the number, availability, and concentration of doctors and hospital beds, operate on the individual's demand and utilization by influencing both a person's perception of his actual needs and his ability to alleviate these needs through the availability of medical services. Thus, individuals living in rural areas may appear to have no need due to the lack of trained medical practitioners in these areas. Of course there is no reason why this should be a rural phenomenon since the availability of doctors in adjacent urban areas such as Harlem and Central Park West differs drastically. Since the physician is often considered the de facto demander of medical services, the inability of a person to see a doctor may effectively cut off his demand and utilization of all other medical services. In addition, even if a trained medical practitioner

diagnoses an individual's actual needs, the person may be unable to get his needs treated for some time due to the lack of or overcrowded conditions in many hospitals (especially in operating rooms). From an operational point of view supply constraints are difficult to measure. Physician/ population ratios are not necessarily good indicators, due to wide variations in the area covered, or to racial and other socio-economic barriers to treatment.

CHAPTER IV

THE NCHS DATA

The Data

The data employed in our estimation effort are derived from the 1967 Health Interview Survey of the National Center for Health Statistics. The survey is a multi-stage probability sample of the civilian, non-institutionalized population of the United States. Approximately 42,000 households containing about 134,000 persons were sampled. The basic purpose of the sample is the determination of the incidence of morbidity in the U.S. population.

The sample contains demographic, economic, and medical information on individuals within the family context.[1] The demographic variables include the usual data on the age, race, sex, family size, residence, marital status, etc. of the individual. The economic information includes the individual's education level, occupation, industry, class of work, education of the family head, family income, amount of hospital bills and alternative sources of payment (welfare, insurance, self, Medicare, etc.) of these bills and the cost of all doctor visits made within two weeks of the survey interview. The medical information contains the number of days

1. Households are interviewed and each individual member of the household is surveyed. It is thus easy to identify family membership and aggregate individual records into family units.

in the hospital during the past year,[2] the type of hospital, the number of out-of-hospital doctor visits in the past year, the type of doctor, the physical conditions of the individual data on home care for those over 55, data on the number and type of operations, and the number of work loss and restricted activity days.[3]

Limitations

Since the data source was primarily designed for the purpose of determining the incidence of morbidity in the U.S. population, several limitations are inherent in its use for demand analysis. First, the basic medical service utilization data contain days in the hospital, number of doctor visits in the past year, and measures of home care for those over 55. There are no data on drugs, appliances, dentistry, diagnostic tests, or in-hospital doctor visits. Second, the insurance data (actually third party payment data) apply only to hospital bills. Furthermore, there are no data on the insurance status of nonusers of hospital services (about 88 percent of the sample) and even for the users of hospital services, no data exist regarding the provider of insurance (i.e. employer or self) or the premiums, copayments, and deductibles. Third, no insurance data are available regarding out of hospital doctor visits; and cost data are available only for those doctor visits that took place within two weeks of the interview date. Fourth, data on home care are available only for those over 55.

2. Actually, the source of payment questions refer to the number of days in the hospital which differs from number of days in the hospital in the past year, to the extent that an individual had a hospital episode this year that extended back over the previous year. The two hospital utilization measures differ only marginally. The number of days in the hospital variable is used by us in our empirical estimates due to this correspondence with the payment variables.

3. See [21] for a detailed statistical analysis of the underlying data.

Fifth, the only resource variable provided is family income and this is coded into 11 categories. No data exist on the incomes or wage rates of individuals and no information is available concerning the existence of paid sick leave.[4] Sixth, no information on the supply of medical services and extremely limited information about the types of reimbursement system faced by suppliers is contained in the survey. This is a fairly serious restriction, since, as discussed above, the observed medical utilization responses are to some extent constrained by the availability of supply.

In order that the reader not be given the incorrect impression that the NCHS-HIS yields totally worthless data, it might be useful to recall the specific advantages of this data set: 1) the sample is by far the largest health survey undertaken on a recurrent basis; and 2) the survey generates perhaps the best morbidity statistics of any survey sample previously employed to estimate the effects of economic, psychological, and demographic factors on the utilization of medical services. The principal advantage of these data, however, is that they were made available on a micro basis; that is, the data refer to individuals. Thus, they can be manipulated, aggregated, and analyzed in any manner which the user wishes.

Our empirical estimation effort to which we now turn is largely dependent on the preceding constraints in at least two ways. First, since adequate price data exist only for hospital services, we restricted our demand estimates to hospital services.[5] Second, since adequate insurance data exist

---

4. See [24] for an elaboration of this point.

5. See [28] for a theoretical derivation of alternative model price measures.

only for the users of hospital services, we limited our estimation efforts to only users of these services.[6]

6. As Holahan and Wilensky point out, any elasticity computed from an equation based on only the users of hospital service is not a true elasticity of expenditures (or utilization) with respect to price. If:

ε_H = elasticity of hospital utilization with respect to price

ε_A = elasticity of admissions with respect to price (admission elasticity)

ε_X = elasticity of hospital utilization per admission with respect price (length of stay elasticity)

Holahan and Wilensky [36, Appendix I] show that:

$$\varepsilon_H = \varepsilon_A + \varepsilon_X$$

Thus, ε_X is the elasticity measure computed from data which contain only users of hospital services; whereby ε_H is the "true" elasticity of expenditures with respect to coverage.

CHAPTER V

EMPIRICAL RESULTS

Statistical Methodology

The primary statistical technique employed in this study is known as multiple classification analysis (MCA). Except for certain conveniences relating to the form of inputs and outputs, MCA is equivalent to conventional least squares regression using qualitative (dummy) independent variables. Mathematically, the two techniques are identical.[1] The underlying theoretical and statistical considerations of MCA are discussed by Melichar[2] and Suits.[3]

All of the independent variables used in this study are in the form of dummies. This is done for two reasons: first, the survey data of the NCHS were generally given to us in dummy form. This was true even for family income which was coded into 11 categories; second, even if the data were available in continuous form, it would be desirable to code them into dummies to test for nonlinearity of effects, a possibility generally neglected in previous studies. Dummy variables allow freer functional forms than do conventional regression estimates based on continuous variables.

Given the qualitative nature of the independent variables, the MCA technique was chosen in preference to more conventional regression programs primarily on the basis of convenience in input requirements and in the form

1. See [3].
2. See [23].
3. See [32].

and content of output. An essential distinguishing feature of MCA is that the estimated intercept of the constant term is equal to the overall sample mean, with the coefficients of the independent variables measuring net deviations from the mean. This feature permits the inclusion of all independent variables in a class, rather than the omission of one to prevent matrix singularity which is usually done in ordinary least squares analysis. "The MCA coefficients are all expressed as adjustments to the grand mean, not deviations from the single class which must be excluded from each set when dummy variables are used."[4,5]

To illustrate, suppose we wish to relate hospital utilization (D) to income status (Y_1 = income less than \$3,000, Y_2 = income between \$3,000 and \$6,000, and Y_1 = income greater than \$6,000) and race (W = white, N = nonwhite). Having run MCA across a cross-section of families, we obtain the resul $D = 4.5 = 3.2\ Y_1 + 0.4\ Y_2 - 2.9\ Y_3 - 2.6\ NW + 1.7\ \bar{W}$. The equation indicates that the average number of days spent in the hospital by persons in the sample was 4.5. If no other information were known about an individual, he/she would be expected to spend 4.5 days in the hospital. Poor persons, however, spend fewer days than others in the hospital (4.5 - 3.2 = 1.3 days, on average) even after correcting for their racial composition. Similar interpretations may be given to the race coefficients; nonwhites have a lower than average period of utilization (4.5 - 2.6 = 1.9 days), whites have a higher than average utilization (4.5 + 1.7 = 6.2 days).

4. [3, p. 17].

5. The constant term equals the sample mean in MCA due to a constraint imposed by the computer program and because of a property of regressions. The weighted sum of the coefficients of classes within a given predictor (such as levels of education) is constrained to equal zero. Further, it can be shown that a regression plane passes through the point of means. [18, pp.9-1 Consider $\bar{y} = a + b\bar{x}$. Clearly by constraining $b = 0$, then $\bar{y} = a$. The computational technique required to satisfy the constraint is given in [23].

The estimating equations employed in this study are of the form: $Y = a + b_{x1} X_1 + \ldots + b_{xn} X_n + b_{z1} Z_1 + \ldots + b_{zn} Z_n$, where X and Z are sets of dummy variables termed "predictors." In the above sample, income is one predictor; race another. Each predictor is comprised of a number of categories. Low (Y_1), medium (Y_2), and high (Y_3) are the three categories of the income predictor; white and nonwhite are the two categories of the race predictor.

The results of our MCA runs are presented in Appendix Tables I through IV. Included for each equation is the sample mean, the simple unadjusted deviation from the mean in each category of each predictor, the regression coefficients (expressed as deviations from the overall mean and termed "adjusted coefficients"), the percent distribution of cases by categories of predictors, and the coefficient of determination ($\bar{R}^2$, corrected for degrees of freedom). Significance is determined by the F tests for sets of coefficients. Predictors which were significant at the .05 level are noted with an asterisk. The F test of significance used was based on the criterion of whether the given predictor explained a significant portion of the variance of the dependent variable, holding constant the other predictors. There is some question about the validity of F tests when weighted survey data are used, as was the case in our analysis.[6] "When using weighted data, the interpretation of the F statistic becomes difficult ... the user... is warned that the assumption of independent random sampling, which underlies the F test, is being violated when the data are 'weighted up.' Furthermore, if the weights themselves bear any relationship to either the dependent or predictor variables, this may affect the value of the F statistic. There

6. The NCHS is a self-weighted sample and weights should therefore be used in all regressions.

appears to be no easy general solution to this problem."[7] We chose what we felt to be a conservative course of action. F tests are computed without weights, which has the effect of lowering the F value. This has the effect of overstating the standard error of each predictor, so that we tend to understate significance. The choice was between this and an overstatement of significance. For purposes of comparison both weighted and unweighted F tests were computed and differences were marginal.

Results of Expenditure Regressions

The regressions reported in the Appendix tables show the relation between total expenditures on hospital services, excluding in-hospital physician services (the dependent variable), economic influences (price and income variables) and control factors (age, sex, education, family size, marital status and location).[8] The runs were limited to those reporting at least one day of hospital utilization. Separate regressions were run for the total population, adult males, adult females, and children. The results for each of these population groupings will be discussed in turn after some general comments are presented.

In general, the R^2's are low, which is in consonance both with other cross-section analyses using large scale sample surveys and also with other studies of the demand for health services. Survey data reflect wide variations in individual behavior patterns caused by short-run fluctuations in economic or family status. This tends to depress reported R^2's below those reported for more aggregative regressions.

---

7. [3, p. 98].

8. The rationale for including these variables is contained in Chapter IV. Initial regressions were run using hospital days as a dependent variable and a variety of additional independent variables. A number of the variables were dropped because of insignificance due to collinearity. These initial results are discussed at the end of this chapter.

One result of particular importance is the high incidence of nonlinear effects indicated by the regressions. Nonlinearities are observed in the effects of family size, education, family income, and prices. Previous analyses have generally neglected these nonlinearities or have attempted to capture them with fairly crude adjustment mechanisms, such as adding the square of price as a separate independent variable. Our results indicate that more precise variables are required to portray the situation with any accuracy.

There is also evidence that, while there are similarities across population subgroups, the economic determinants of health care utilization differ across males, females, and children. Thus, coefficient patterns (although not magnitudes) for education, marital status, family size, and race are similar for the three population subgroups.[9] There are, however, significant differences in the impact of income and price depending on whether males or females are the unit of analysis. Interactions of this sort should be recognized in any future work on the determinants of health service utilization.

Total Population

Two of the nine variables included in this equation are insignificant. Surprisingly, education is not significant at the .05 level in contrast to results reported in other health utilization studies.

The age variable is particularly well behaved and in consonance with a priori expectations. Bills for very young children (less than 1 year) are below the average for all age groups, but above the average for other age

9. Education and marital status refer to the family head in the case of the children equations.

groups of children (i.e. 1-17 years). The very youngest children seem susceptible to the most urgent (and expensive) types of medical problems. Above the age of 1, bills decline successively until the age of 44; thereafter, complications of old age rise and hospital bills increase accordingly. Persons aged 65 or older pay bills of approximately $628 (holding constant other factors), in contrast to an average annual bill of $376 for hospital users in the 25-44 age group.

Both sex and marital status variables are significant, although the latter is barely so at the 0.05 level. Male hospital users report bills which average 15 percent above those reported by female users. This apparently stems from differences in average days spent in the hospital: males reported an average of 20 days, while females reported 11 days.

The income variable is significant. Results, however, are not entirely monotonic; that is, coefficient values and signs tend to jump around in a manner not consistent with a priori expectations. What does appear to hold true, however, is that those with family income less than $7000 spend about $25 less on average than those with larger family incomes, other influences held constant. Thus, there seems to be a kink around $7000. It would be interesting to enter this variable in continuous form, with a shift term indicating whether family income is above or below $7000, but the nature of the NCHS data precludes this.

The price variable, percent of bill paid by self, is significant even at the 0.01 level, but the coefficients do not appear entirely reasonable. Those paying zero percent of their bills report only slightly higher than average expenditures. Perhaps this reflects pressures from those who actually do pay the bills, but the relatively small positive coefficient seems to be belief by recent Medicaid experience. Another peculiarity is the relatively

large coefficient (+ 302.40) for the category in which 76-99 percent of bill is paid by self. This may have something to do with deductibles and coinsurance features, but this is not entirely clear. Taking the midpoint of this category (.875) and multiplying by the class mean (422 + 302 = $724) suggests that individuals in this class paid about $634 for the year. This seems rather high, implping a deductible of greater than $110. The one category which does seem correct is when 100 percent of the bill is paid by self. The result implies that, other influences constant, persons paying the full amount of their bill spend about $312, which is significantly below average.

Adult Males

The results of this equation are quite similar to those of the total population. The mean of $555 is higher than in the previous case, and this has been discussed previously. The R^2 (0.05) is relatively low, but significant even at the 0.01 level.

Only three of the eight predictors are significant in this run. A notable difference from the run for the total population is the lack of significance of the income predictor in the run for adult males. The coefficient patterns, however, are similar to those in the previous run.

Again the age predictor is highly significant and in consonance with a priori expectations. Older males (65 or older) stay in the hospital longer and consume more intensive care than do younger persons. Consequently their average bills are some $316 above those reported by male users in the 18-24 year old class.

Urban-rural location affects expenditures significantly. Male hospital users in urban areas spend over $18 above the average and males in farm areas

spend about $112 below average. Since a similar finding appeared for days of utilization, we hypothesize that this reflects the availability of supply. This conjecture is buttressed by the fact that similar results obtain even after correcting for the incidence of conditions.

The price predictor shows the same peculiarity as noted previously; the coefficient for zero percent paid by self is too low to accord with expectations; and that for the category 76-99 percent is too high. There is obviously a consistent nonlinearity here which would be masked if the regression could be run in continuous form. However, in this case, the category includes only about 15 observations which is too few to allow confidence in this result.

Adult Females

Three of the eight variables included in this regression were not significant, even at the 0.05 level. Again. multicollinearity appears to be minimal but not entirely absent.

The effect of age on hospital bills for this group is a monotonic increasing sequence. Women 65 years of age or older reported bills which, when other influences are held constant, amount to approximately $300 more than bills reported by those in the 18-24 class. The expected value of bills for women in the upper group who use hospital services is $600.87.

In this regression, as in many of the others reported previously, education is not significant. The problem can not be attributed to multicollinearity (note that correcting for the influence of other variables does not change the unadjusted deviations significantly). Rather, the pattern of coefficients appears to be erratic.

The coefficients of the family income variable suggest that medical

expenditures are "normal", in the sense of generally increasing as income rises. The coefficient for the 0-$4999 category is not to be trusted, since this class probably includes a number of persons whose incomes are temporarily depressed. Further, the category includes only 24 cases, too few to be considered statistically reliable. After the lowest income category, coefficients become generally less negative up to the $7000-9999 category which is positive and seemingly out of place. The sharp change in this coefficient before and after adjusting for other influences suggests inter-correlation. Two likely reasons for explanation are the age and education predictors: very few older women (age 65 or above) reported family incomes between seven and ten thousand dollars, and a disproportionate number of these responding "don't know" to the years of school completed are clustered in this income category.

The price variable is significant at the 0.01 level but the pattern of the coefficients is puzzling. We expect, naturally, that the larger the percent of the bill paid by self the lower would be the utilization, and consequently the lower the total bill. However, other influences, notably deductibles limits and copayment features, could be operative here, adding noise to the basic data. One particularly troublesome category of this variable is the first. If zero percent of the bill is paid by self, we could clearly expect a higher than average utilization. This does not hold even for the unadjusted figures. Again, the coefficient for the category 76-99 percent is peculiarly (but consistently) out of place.

Children

There are reasons to hypothesize that expenditures on medical services for children contain a large discretionary component. Given the plethora of childhood diseases and the fact that there is a great deal of uncertainty on the part of parents about their origin, nature, or severity, one would expect that the variance in service consumption for children would reflect largely price and family resource variances. Put another way, all (or most) children are susceptible to illness. Which of the children use how much of what kind of service should thus depend heavily on economic circumstances. This would suggest that we would find higher price and income elasticities for children than for adults. We might also expect to explain a greater proportion of the variance in health service utilization by children than by adults.

These hypotheses seem correct as far as they go. However, our analysis is restricted to hospitalization, which is far from a discretionary item. Children who are sick enough to be in the hospital can hardly be called discretionary consumers. To this extent the variance in hospital utilization across children could be a function more of aversion to risk (by parents or physicians) than of economic circumstances. Thus, while we expect relatively high price and income elasticities for physician visits, we might expect relatively low price and income elasticities for hospital days utilized. The empirical question to be answered is whether at the margin economic factors are important.

Judging from Appendix Table IV, the answer is no. The family income variable is not significant, and while the price predictor is significant, the coefficients show no logically clear or consistent pattern. Only at the extremes do the results conform with theory--those whose parents pay

zero percent of the bill have longer than average stays while those whose parents pay 100 percent stay fewer days than average. Between the extremes little can be said, and this conforms with previous results.

Only three of the eight predictors in this equation are significant. As expected, the very youngest children have the highest average length of stay, while 1-5 year olds have below average stays. The average stay for 6-17 year olds is nearly identifical to the average for all children. The education of the family head is significant in this equation, in contrast to most of our previous results. The coefficient patterns suggest that heads with higher education either prefer to take care of their children at home rather than in a hospital, or else they consume more preventive care for their children than do those in the lower education categories. It is tempting to suggest that the presumed intercorrelation between income and education led to the insignificance of the former predictor. Such, however, does not appear to be the case. The difference between the unadjusted and adjusted income coefficients is minimal, and since the difference reflects correction for other influences, it seems safe to conclude that the income predictor would not attain significance even if education were omitted from the regression.

The R^2 is quite low but the F test of significance shows that all the variables, when taken together, are significant to the 0.01 level.

It would be useful to review the results of another study employing the 1967 NCHS-HIS data in which hospital utilization (days in the hospital) rather than hospital expenditures were employed as the dependent variable in the behavioral equations.[10] Several sets of equations were estimated

10. See [21]. For an elaborate discussion of alternative forms of hospital output measures, see [7].

for adult males, adult females, and children. Demographic and economic variables comparable to those employed in our expenditure equations were used in the utilization equations. However, the utilization equations were manipulated in several additional ways. First, in each of the three population subgroups, equations were estimated for the total subgroup (users and nonusers of services), and for users of services. Second, a physical condition code variable (representing an aggregate of the International Classification of Disease Codes) was entered as an independent variable in several of the behavioral response functions. Third, several variations of the payment variable were tried. Fourth, behavioral equations were estimated for two highly specialized types of hospital days: surgery days for men, and maternity days for women. A summary of the results obtained for each of the population subgroups follows.

The statistical results from fitting five behavioral utilization equations to data for alternative subgroups of the adult male population were somewhat disappointing.[11] The "best" equation in terms of explanatory power accounted for about six percent of the variance in hospital utilization. After excluding nonusers, the R^2 dropped to .03. Eliminating "don't know" responses and predicting highly specialized types of days led to no appreciable improvement in the results. Inclusion of the condition code variable in the behavioral response led to some improvement in the explanatory behavior of the equations. Actually, the physical condition code and payment variables provide substantially more explanatory power than do large sets of demographic and economic variables.

Several behavioral results are discernible from utilization equations.

11. The five equations fitted for adult males included one for all adult males and four for only users of hospital services. Of these four equations, one contained surgery days as the dependent variable and the remaining three equations contained variations in the price and physical condition code independent variables with number of hospital days as the dependent variable.

First, the condition predictor was statistically significant in every instance and accounted for a significant amount of the explanatory power (relative to the other variables) in every equation it was used. The three payment variables, amount paid per day by self, amount paid per day by others and interaction variables (amount paid by self per day by amount paid by others per day), were statistically significant in three out of five cases and generally displayed the expected inverse relationship between quantity demand and price. The occupation and industry variables were statistically significant in almost all cases and, despite the wide variations in each of the industry and occupation categories, appeared to behave in a meaningful manner. The age predictor is statistically significant about half the time and generally indicates after adjustment for the other independent variables that older males have below average utilization. The race, education, and income predictors were generally not statistically significant or representative of any overall systematic behavior.

In comparing the empirical results from fitting three utilization equations to the NCHS data for adult females, two factors are quite apparent.[12] First, the explanatory power of the equations is extremely low ($.02 \leq R^2 \leq .09$). This is even the case for a highly specialized service such as maternity days ($R^2 = .09$). The second factor of interest is that although the estimated equations are far from exceptional from a predictive point of view, several interesting behavioral effects may have been uncovered. First, the statistical significance of the price variables and the inverse relationship between utilization and price in all equations would appear to indicate that price considerations are of importance to individual decision-making in the health

12. The three equations fitted as the dependent variables for adult females, employed hospital days for all adult females, hospital days for adult female users, and maternity days.

area. The need predictor of number of doctor visits in the past year was statistically significant in the two (non-specialized) hospital day equations and appeared to indicate that physician services and hospital visits may be substitutable over some range and that the doctor is the de facto demander of hospital services. The statistical significance of the age variable (another need factor) in both hospital day equations suggests the not too suprising result that hospital utilization is strongly dependent on age. The statistical significance of the taste and preference indicators of family size, presence of children less than 12, and marital status in the two hospital day equations suggests existence of complementarities of family health needs and the importance of free home care in determining hospital health needs and the importance of free home care in determining hospital utilization for adult females. The urban-rural indicator was another taste and preference variable that was statistically significant the two times it was used, indicating either that individuals in urban areas have greater tastes and preferences for hospital services than those in rural areas or that the availability of hospital services is greater in urban than in rural areas. Although the supply indicator of state of residence was statistically significant two of the three times it was used, the results were somewhat erratic and it is our feeling, that since intra-state distributions of medical facilities have large variances, the use of single supply measure for an entire state is both questionable and inaccurate.

Two basic behavioral equations are estimated by the MCA technique in order to measure the hospital utilization of children. The first equation is based on data for all children, and the second equation is estimated only for users of hospital services. The statistical results for the equation based on all children are superior to those for the users-only equation

with regard to explanatory power (R^2 = .13 versus R^2 = .03). The number of children, number of doctor visits, amount paid by self per day and amount paid by others per day variables were statistically significant in the total children equation and race, number of doctor visits; and payment interaction variables were statistically significant in the users-only equation.

Several interesting statistical relationships were observed. First, the inverse relationship between the price variables and utilization was strongly evident in both utilization equations. In addition, the coefficients of these predictors were statistically significant in both behavioral equations. Second, the number of doctor visits predictor was statistically significant and behaved in the same way in both equations. Third, the race predictor behaved analogously in both equations and showed that non-white children on the average spend more time in the hospital than white children. Thus, despite the rather poor statistical fit, need components such as race and number of doctor visits and price components defined in terms of alternative sources of bill paid per day appeared to be of significance in explaining the hospital behavior of children.

CHAPTER VI

CONCLUSIONS

Perhaps our basic conclusion is that the analysis of a new medical data base, the 1967 NCHS-HIS, yields results that are consonant with previous studies. There are, however, at least two aspects of our results that should be reiterated: a) the apparent existence of a large random component in the demand for medical services; and b) the presence of non-linearities in the estimated demand relationships.

The poor explanatory power (the independent variables in almost all cases accounted for less than 10 percent of the variation in hospital expenditures) of our estimated equations indicates that we have been unable to account for a large part of the variation in individual hospital expenditure decisions. This inability to explain the demand for services is, as discussed above, an inherent aspect of almost all health services demand studies. There are several plausible reasons for these somewhat disappointing results. These include data limitations, lack of a priori knowledge of the underlying behavioral relationships, and the presence of stochastic elements in the demand for medical services.

These first two exigencies--data limitations, and the lack of theoretical knowledge about the underlying behavioral relationships--have been discussed above. The narrow design objectives of most medical surveys have in many cases precluded the collection of data on many of the relevant economic (both income and price) variables. This, in addition to the relatively new

and largely undeveloped state of the theory of health economics, could to some extent, be responsible for the mediocre results obtained in most health demand studies.

Another explanation is the possible presence of a large random element in the demand for medical services. If most illnesses and diseases are occurrences from an individual's point of view and if, in general, treatment is obtained for a recognized illness regardless of cost, then one could not expect to explain medical service utilization on the basis of the usual economic and demographic variables. To the extent that many illnesses (especially acute illnesses) are random events (injuries, contagious diseases, etc.) and to the extent that medical care is available regardless of individual ability to pay (Medicare, municipal hospitals, neighborhood health centers, Medicaid, etc.), it should not be surprising that health demand studies have been unable to empirically substantiate regular behavior patterns.

A second and related finding in this study is the existence of non-linearities in the estimated demand relationships. The general erratic behavior of the various income and price categories (as well as other variables) indicates that the regular relationship found by using continuous variables and standard multiple regression analysis (MRA) methods may lead to inaccurate estimates of actual behavior. In addition, the non-linearities in the price and income variables in this study suggest that the usual elasticity estimates obtained (by using continuous variables and MRA techniques) in other studies should be interpreted with great caution. This is especially true when these estimated price and income elasticities are employed in simulation models to obtain the cost and distributional impacts of alternative national health insurance plans. The results of this study suggest that the regular behavior

patterns indicated by these usual price and income elasticity measures are somewhat crude approximations to the 'actual' underlying behavior.

It is apparent from this as well as most other studies in the health area that much work remains to be done in the determination of individual (or family) behavior. This work includes the development and implementation of new econometric and statistical techniques that can readily be employed to analyze medical economics data with its attendant peculiarities. Furthermore, the development by multi-disciplinary groups of better and perhaps more complex survey instruments may result in more reliable and consistent data bases. Perhaps of greater importance is the development and analysis of new sources of data. Indeed, given the relatively poor results obtained in most health studies employing several different data bases, experimentation on actual population subgroups may be one of the few techniques available to measure the "true" behavioral responses.[1]

The importance of developing techniques for and analyzing health economic data bases cannot be overemphasized. In addition to shedding some light on behavior in the health utilization area in general, the exploration of such data may provide an important first step in the development of a systematic and empirically verifiable theory of health economics. The development of such a theory with concommitant behavioral postulates could be an invaluable policy tool in evaluating our entire health system.

1. The Office of Economic Opportunity is currently planning to run such an experiment.

APPENDIX

The Behavioral Equations

TABLE I

Dependent Variable: Total Hospital Bill
Group: Total Population

Mean = 421.78
R^2 = 0.09
N = 10073
F = 24.97*

Variable	Unadjusted Deviation	Adjusted Coefficient	Percentage of Cases
AGE*			
<1	-123.00	- 61.19	1.5
1-5	-186.81	-160.88	7.2
6-17	-158.52	-139.39	12.4
18-24	-123.87	-108.01	15.9
25-44	-24.64	-26.05	30.5
45-64	174.31	141.73	22.8
65+	233.37	206.20	9.8
RACE*			
White	2.86	a	92.5
Nonwhite	-33.53	a	7.5
SEX*			
Male	38.33	38.46	36.7
Female	-21.58	-22.42	63.3
FAMILY SIZE			
1	126.05	-31.99	6.4
2	137.40	9.76	19.5
3	-6.60	13.06	18.9
4,5	-51.44	1.30	34.7
6-8	-74.16	-8.00	17.0
8+	-76.65	6.63	3.5
MARITAL STATUS*			
Married	29.35	-0.02	64.6
Never Married	20.27	64.05	6.7
Widowed, div. or sep.	151.80	40.43	8.9
< 17 years	-168.46	-40.12	19.8
EDUCATION OF INDIVIDUAL			
6-8	74.43	16.77	22.7
9-11	-21.61	5.49	21.6
High School Graduate	-35.44	-9.77	36.3
13-15 years	-19.26	-14.20	10.2
College Graduate	-0.87	-15.58	5.7
17 + years	71.54	48.72	2.7
DK	175.50	98.82	0.7

Table I, continued

Variable	Unadjusted Deviation	Adjusted Coefficient	Percentage of Cases
URBAN-RURAL*			
Urban	26.92	18.36	70.0
Rural Farm	-89.19	-111.64	5.6
Rural Nonfarm	-55.30	-54.55	24.4
FAMILY INCOME *			
< 500	156.93	106.28	0.5
$500-999	49.37	-14.41	1.2
1000-1999	57.19	-10.22	4.7
2000-2999	61.91	28.28	5.8
3000-3999	-5.06	-3.32	7.5
4000-4999	-42.32	-7.95	9.4
5000-6999	-44.82	-12.42	20.9
7000-9999	-21.99	4.16	24.5
$10,000-14,999	14.72	11.81	16.0
$15,000+	108.72	92.11	6.9
DK	81.30	55.01	2.5
PERCENT OF BILL PAID BY SELF			
0%	2.31	3.06	35.1
1-10%	105.05	92.18	13.0
11-25%	41.17	24.60	16.3
26-50%	- 5.30	-11.28	11.6
51-75%	26.75	4.41	4.6
76-99%	302.26	302.40	1.2
100%	136.77	-109.52	18.2

TABLE 2

Dependent Variable: Total Hospital Bill
Group: Adult Females

Mean = 425.27
R^2 = 0.08
N = 5420
F = 13.2*

Variable	Unadjusted Deviation	Adjusted Coefficient	Percentage of Cases
AGE*			
18-24	-145.58	-124.34	24.1
25-44	-45.69	-37.74	42.5
45-64	148.54	121.22	23.6
65+	198.84	175.60	9.7
RACE			
White	3.32	-0.14	91.8
Nonwhite	-36.95	0.86	8.2
FAMILY SIZE			
1	141.25	-6.09	7.2
2	93.18	4.48	21.3
3	-25.27	16.12	21.2
4-5	-41.62	3.55	32.9
6-8	-58.65	-26.30	14.5
8+	-85.41	-38.75	2.9
MARITAL STATUS*			
Married	-22.36	-10.22	82.3
Never Married	32.35	73.96	5.4
Widowed, divorced or sep.	135.84	35.17	12.3
EDUCATION OF INDIVIDUAL			
0-8 years	86.70	35.94	20.4
9 -11 years	-26.93	1.50	21.2
High School Graduate	-33.17	-10.79	41.5
13-15 years	5.09	-5.36	9.5
College Graduate	-23.85	-51.67	5.5
17 + years	120.50	35.70	1.4
DK	214.49	100.37	0.5
URBAN-RURAL*			
Urban	28.89	25.49	70.0
Rural Farm	-109.35	-103.95	5.2
Rural Nonfarm	-61.54	-50.55	24.8

Table 2, continued

Variable	Unadjusted Deviation	Adjusted Coefficient	Percentage of Cases
FAMILY INCOME			
< $500	138.02	219.43	0.8
$501-999	34.69	78.92	1.4
$1000-1999	-33.81	-3.74	6.5
$2000-2999	108.98	94.16	6.4
$3000-3999	46.90	68.45	8.6
$4000-4999	-77.12	-37.27	9.2
$5000-6999	-55.80	-40.44	17.8
$7000-9999	-51.20	-48.53	22.4
$10,000-14,999	44.14	20.20	16.6
$15,000+	126.98	88.28	7.5
DK	46.19	43.39	2.8
PERCENT OF BILL PAID BY SELF			
0%	-10.99	0.29	39.9
1-10%	134.37	125.97	14.3
11-25%	56.83	48.32	18.3
26-50%	-42.60	-52.88	10.2
51-75%	-76.34	-92.48	4.1
76-99%	237.94	170.82	0.6
100%	-152.30	-162.99	12.6

TABLE 3

Dependent Variable: Total Hospital Bill
Group: Adult Males

Mean = 555.28
R^2 = 0.05
N = 2495
F = 3.9*

Variable	Unadjusted Deviation	Adjusted Coefficient	Percentage of Cases
AGE*			
18-24	-176.14	-178.73	11.6
25-44	-105.01	-110.44	30.2
45-64	69.02	69.27	40.1
65+	135.94	137.33	18.0
RACE			
White	2.17	a	94.4
Nonwhite	-36.23	a	5.6
FAMILY SIZE			
1	-32.00	-82.00	9.8
2	69.91	12.44	30.9
3	-13.38	- 1.42	18.7
4,5	-30.51	19.33	27.6
6-8	-72.41	5.56	11.2
8 +	40.89	115.52	1.7
MARITAL STATUS			
Married	8.31	-15.32	79.3
Never Married	-100.40	43.37	11.8
Wid., Divorced, or Sep.	59.35	51.21	8.9
EDUCATION OF INDIVIDUAL			
0-8 years	28.21	-11.84	32.1
9-11 years	-26.30	0.10	19.0
High School Graduate	-36.58	-2.78	27.3
13-15 years	-69.34	-36.21	11.5
College graduate	119.46	93.83	5.3
17 + years	161.14	134.80	3.7
DK	154.36	92.67	1.1
URBAN-RURAL*			
Urban	33.22	32.50	69.6
Rural Farm	-120.42	-141.81	7.0
Rural Nonfarm	-62.81	-65.91	23.4

Table 3, continued

Variable	Unadjusted Deviation	Adjusted Coefficient	Percentage of Cases
FAMILY INCOME*			
< $ 500	156.71	48.74	0.4
$500-000	27.59	-66.14	1.5
$1000-1999	45.72	-36.32	5.0
$2000-2999	18.70	-14.89	6.4
$3000-3999	-42.21	-41.77	7.7
$4000-4999	-31.34	-3.89	9.6
$5000-6999	-37.55	-13.23	21.3
$7000-9999	-0.84	14.97	23.4
$10,000-14,999	3.64	-6.32	15.3
$15,000+	114.57	92.24	6.8
DK	78.39	52.61	2.6
PERCENT OF BILL PAID BY SELF*			
0%	6.92	-3.81	30.5
1-10%	131.36	110.75	12.3
11-25%	29.84	6.12	15.4
26-50%	-2.22	-1.43	13.0
51-75%	4.82	46.11	5.9
76-99%	316.28	328.31	1.6
100%	-141.74	-98.78	21.4

TABLE 4

Dependent Variable: Total Hospital Bill
Group: Children
Mean = 255.97
R^2 = 0.02
N = 2158
F = 2.3*

Variable	Unadjusted Deviation	Adjusted Coefficient	Percentage of Cases
AGE*			
<1	42.82	70.54	7.0
1-5	-21.00	-15.62	34.4
6-17	7.30	0.25	8.6
RACE			
White	-1.87	-1.31	92.0
Nonwhite	21.70	13.37	8.0
SEX			
Male	-0.45	-0.91	55.4
Female	0.63	1.49	44.6
FAMILY SIZE			
1	-243.58	-136.31	0.1
2	140.87	168.57	1.3
3	11.31	24.04	13.5
4,5	-14.29	-12.41	48.1
6-8	7.98	2.33	30.0
8+	20.35	1.93	7.0
EDUCATION OF HEAD*			
0-8 years	3.56	18.14	17.6
9-11 years	34.93	14.96	25.8
High School Graduate	-14.97	-15.35	33.8
13-15 years	-22.95	-26.96	10.7
College graduate	-37.55	-70.91	6.5
17 + years	0.94	-30.52	5.0
DK	45.08	46.15	0.7
URBAN-RURAL			
Urban	12.20	11.18	70.4
Rural Farm	-54.42	-42.22	4.8
Rural Nonfarm	-24.01	-24.22	24.8

Table 4, continued

Variable	Unadjusted Deviation	Adjusted Coefficient	Percentage of Cases
FAMILY INCOME			
< $500	-124.08	-146.73	0.3
$501-999	-15.94	-18.65	0.5
$1000-1999	106.01	107.03	1.9
$2000-2999	16.23	26.09	3.5
$3000-3999	-28.90	-30.85	5.9
$4000-4999	-32.09	-25.93	9.2
$5000-6999	-15.61	-23.47	23.3
$7000-9999	1.66	-1.23	29.9
$10,000-14,999	11.54	16.85	17.3
$15,000+	47.29	65.90	6.7
DK	33.72	32.57	1.6
PERCENT OF BILL PAID BY SELF*			
0%	15.54	13.89	41.5
1-10%	-9.48	-1.59	13.2
11-25%	24.68	35.98	16.1
26-50%	17.47	22.91	9.7
51-75%	- 60.72	-66.89	2.1
76-99%	313.64	326.82	0.8
100%	-72.52	-88.94	16.6

NOTES TO APPENDIX

All equations fitted to weighted data.

N = unweighted number of observations

Unadjusted Deviation - deviation of class mean from the overall mean.

Adjusted Coefficient - deviation of class mean from the overall mean after adjustment for the effect of all other predictors.

* = statistically significant at the 0.05 level.

Expenditure Data is biased downward due to underreporting.

a = computer precision error.

REFERENCES

1. Andersen, Ronald. A Behavioral Model of Families' Use of Health Services (Chicago: Center for Health Administration Studies, 1968).

2. Andersen, Ronald and Lee Benham. "Factors Affecting the Relationship between Family Income and Medical Care Consumption" in Empirical Studies in Health Economics, Herbert E. Klarman (ed.) (Baltimore: The Johns Hopkins Press, 1970).

3. Andrews, Frank, James Morgan, and John Sonquist. Multiple Classification Analysis (Ann Arbor: Survey Research Center, 1967).

4. Arrow, Kenneth J. "Uncertainty and the Welfare Economics of Medical Care," American Economic Review, 53 (December 1963), 941-73.

5. Arrow, Kenneth J. and Mordecai Kurz. Public Investment, The Rate of Return, and Optimal Fiscal Policy, (Baltimore: The Johns Hopkins Press, 1970).

6. Becker, Gary S. "A Theory of the Allocation of Time," Economic Journal 75 (September 1965), 493-517.

7. Berki, Sylvester E. "On the Economics of Hospitals: Analysis and Review of the Literature," Unpublished Mimeo, 1970.

8. Berki, Sylvester E. "On the Economic Effects of National Health Insurance," Inquiry 8 (June 1971), 37-55.

9. Cramer, J. S. "Efficient Grouping, Regression and Correlation in Engel Curve Analysis," Journal of the American Statistical Association 59 (March 1964), 233-250.

10. Feldstein, Martin S. "An Econometric Model of the Medicare System", Quarterly Journal of Economics 85 (February 1971), 1-20.

11. Feldstein, Paul J. and Sander Kelman. "A Framework for an Econometric Model of the Medical Care Sector," in Empirical Studies in Health Economics, Herbert E. Klarman (ed.) (Baltimore: The Johns Hopkins Press, 1970).

12. Ginzberg, Eli. "Comment," in Empirical Studies in Health Economics Herbert E. Klarman (ed.) (Baltimore: The Johns Hopkins Press, 1970).

13. Ginzberg, Eli and Miriam Ostow. Men, Money, and Medicine (New York: Columbia University Press, 1969).

14. Grossman, Michael. "The Demand for Health: A Theoretical and Empirical Investigation," Unpublished Ph.D. Dissertation, Columbia University, 1970.

15. _____. "On the Concept of Human Capital and the Demand for Health," Journal of Political Economy, LXXX (March/April 1972), 223-255.

16. Henderson, James M. and Richard E. Quandt. Microeconomic Theory: A Mathematical Approach, 2nd Edition (New York: McGraw-Hill, 1971).

17. Jeffers, James R. and Mario F. Bognano. "Medical Economics: An Introduction," Inquiry 7 (March 1970), 4-14.

18. Johnston, J. Econometric Methods (New York: McGraw-Hill, 1963).

19. Joseph, Hyman. "Empirical Research on the Demand for Health Care," Inquiry 8 (March 1971), 61-71.

20. Kalacheck, E. D. and Raines, F. Q. "Labor Supply of Lower Income Workers," in President's Commission on Income Maintenance Programs Technical Studies (Washington, D.C.: Government Printing Office, 1970).

21. Kelly, Terence F. and George J. Schieber. "Factors Affecting Health Services Utilization: A Behavioral Approach," Working Paper 956-2 (Washington, D.C.: The Urban Institute, 1971).

22. Lancaster, Kelvin J. "A New Approach to Consumer Theory," Journal of Political Economy, 75 (April 1966), 132-157.

23. Melichar, E. "Least Squares Analysis of Economic Survey Data," Proceedings of the Business and Economic Statistics Section, American Statistical Association (1965), 1-13.

24. Mincer, Jacob. "Market Prices, Opportunity Costs, and Income Effects," in Measurement in Economics, C. Christ et al. (Stanford: Stanford University Press, 1963).

25. Mushkin, Selma J. "Health as an Investment," Journal of Political Economy 70, Part 2 (October 1962), 129-157.

26. Pauly, Mark V. "An Analysis of Alternative Forms of the Family Health Insurance Plan," Unpublished Mimeo, 1970.

27. _____. Medical Care at Public Expense (New York: Praeger Publishers, 1971).

28. Phelps, Charles E. and Joseph P. Newhouse. "Coinsurance and the Demand for Medical Services," Unpublished Mimeo, 1972.

29. Rafferty, John A. "Patterns of Hospital Use: An Analysis of Short-run Variations," Journal of Political Economy 79 (January/February 1971), 154-65.

30. Rosett, Richard N. and Cien Fu Huang. "The Effect of Health Insurance on the Demand for Medical Care," Paper presented at the AEA Conference, Detroit, December 26-28, 1970.

31. Sonquist, John and James Morgan. The Detection of Interaction Effects (Ann Arbor: Survey Research Center, 1964).

32. Suits, Daniel B. "Use of Dummy Variables in Regression Equations," Journal of the American Statistical Association, 52 (December 1957), 548-551.

33. U.S. Department of Health, Education, and Welfare. United States Statistics on Medical Economics Present Status and Recommendations for Additional Data (Washington, D.C.: Government Printing Office, 1964).

34. U.S. Department of Health, Education, and Welfare. National Center for Health Statistics, Current Estimates from the Health Interview Survey United States - July 1966 - June 1967, Series 10, Number 43, (Washington, D.C.:Government Printing Office, 1968).

35. U.S. Department of Health, Education, and Welfare. Cycle I of the Health Examination Survey: Sample and Response, United States, 1960-1962 (Washington, D.C.: Government Printing Office, 1964).

36. Wilensky,Gail R. and John Holahan. National Health Insurance: Costs and Distribution Effects, (Washington, D.C.: The Urban Institute, 1972).

37. Wirick, Grover. "A Multiple Equation Model of Demand for Health Care," Health Services Research (Winter 1966), 301-346.

38. Yett, D. E. et al. "The Development of a Micro-Simulation Model of Health Manpower Supply and Demand," in Conference on a Health Manpower Simulation Model Proceedings and Report, Volume One, U.S. Department of Health, Education, and Welfare (Washington, D.C.: Government Printing Office,1970).